

Foreword to the EOS Aqua Special Issue

ON MAY 4, 2002, NASA's Aqua spacecraft was launched from Vandenberg Air Force Base in California, carrying on board six sophisticated instruments to observe the earth system and monitor changes in it. A key component of the international, NASA-led Earth Observing System (EOS), the Aqua mission has a particular emphasis on water as it exists throughout the atmosphere and both on and near the earth's surface, including water in its liquid, solid, and vapor forms.

Of the six Aqua instruments, three together form the most sophisticated sounding system ever launched into space: the Atmospheric Infrared Sounder (AIRS), provided by the United States and constituting the 2382-channel centerpiece of the sounding triplet; the Advanced Microwave Sounding Unit (AMSU), also provided by the United States; and the Humidity Sounder for Brazil (HSB), provided by Brazil's National Institute for Space Research (INPE). The AIRS/AMSU/HSB sounding system is designed to meet both NASA's research goals and the operational requirements of the National Oceanic and Atmospheric Administration (NOAA). The infrared and microwave observations are integrated in a way to allow retrieval of temperature and humidity profiles with radiosonde accuracy in all fields of view with 0% to 80% cloud coverage. Surface temperatures, cloud properties, and information on trace gas constituents of the atmosphere are all additionally obtained from the AIRS/AMSU/HSB instruments.

Also on board Aqua is an Advanced Microwave Scanning Radiometer for EOS (AMSR-E), provided by Japan's National Space Development Agency (NASDA). AMSR-E obtains finer spatial resolution and has a broader range of microwave frequencies than was the case with previous satellite passive-microwave instruments, broadening the applicability of the AMSR-E datasets. The AMSR-E data are being used to derive global, all-weather information on such surface variables as temperature, sea ice, snow cover, and soil moisture, plus information on water vapor, rainfall, and sea surface wind speed.

The final two instruments on Aqua are both also on Aqua's sister EOS satellite Terra, launched in December 1999. These are the Clouds and the Earth's Radiant Energy System (CERES; two copies) and a Moderate Resolution Imaging Spectroradiometer (MODIS), both provided by the United States. CERES science is focused on the large-scale energy budget of the earth and on climate change, while MODIS science is focused on a large variety of physical and biological elements and processes in the earth system. MODIS is the highest spatial resolution instrument on the Aqua platform, with products generated at 250-m, 500-m, and 1-km resolutions. Because Aqua crosses the equator at approximately 1:30 A.M. and 1:30 P.M. local time, while Terra crosses the equator at approximately 10:30 A.M. and 10:30 P.M. local time, the presence of CERES and MODIS on Aqua as well as Terra allows not just increased sampling but also increased information on the diurnal cycle of the many

radiative, surface, and atmospheric variables being measured by these two instruments.

At full operations, the Aqua instruments are sending back to earth 89 GB of data a day. A subset of these data is being used immediately in weather forecasting efforts, while all the data are being processed for availability for scientific analysis aimed at improved understandings of the earth system and earth system changes. This substantial volume of data should provide a wealth of information to be mined by earth scientists for years to come.

This special issue of the IEEE TRANSACTIONS ON GEOSCIENCE AND REMOTE SENSING (TGARS) contains 29 papers describing the Aqua mission, the Aqua earth-observing instruments, the science rationale, and many of the algorithms that are being used to process the data into scientific products. It also includes a few sample early results from the Aqua data and details on several of the ongoing and upcoming validation efforts. Over half the papers concern the AIRS/AMSU/HSB triplet, AIRS being the instrument with the most substantial technological developments made for the Aqua mission. The rest of the issue is dominated by papers regarding AMSR-E and MODIS, with papers on CERES appearing instead in the July 1998 TGARS special issue for the Terra (or EOS AM-1) spacecraft and subsequent sources (see publications list at <http://asd-www.larc.nasa.gov/ceres/ASDceres.html>).

It is hoped that this Aqua special issue will provide a convenient reference for scientists using the Aqua data and, at the same time, will broaden the community of people aware of the Aqua mission and the data being generated from it.

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